

Laser Ablated High T_c Superconducting Thin $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Films on Substrates Suitable for Microwave Applications

J.D. Warner, J.E. Meola, K.A. Jenkins, and K.B. Bhasin,
National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio 44135.

The development of high temperature superconducting $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ thin films on substrates suitable for microwave applications is of great interest for evaluating their applications for space radar, communication, and sensor systems. Thin films of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ have been formed on SrTiO_3 , ZrO_2 , MgO , and LaAlO_3 substrates by laser ablation. The wavelength used was 248nm from a KrF excimer laser. During deposition the films were heated to 600° C in a flowing oxygen environment, and required no post annealing. The low substrate temperature during deposition with no post annealing gave films which were smooth, which had their c-axis alligned to the substrates, and which had grains ranging from 0.2 to 0.5 microns in size. The films being c-axis aligned gave excellent surface resistance at 35 GHz which was lower than that of copper at 77 K. At present, LaAlO_3 substrates with a dielectric constant of 22, appears suitable as a substrate for microwave and electronic applications. The films have been characterized by resistance-temperature measurements, scanning electron microscopy, and x-ray diffraction. The highest critical transition temperatures (T_c) are above 89K for films on SrTiO_3 and LaAlO_3 , above 88K for ZrO_2 , and above 86K for MgO . The critical current density (J_c) of the films on SrTiO_3 is above 2×10^6 amperes/cm² at 77K. The T_c and J_c are reported as a function of laser power, composition of the substrate, and temperature of the substrate during deposition.

Resistance versus temperature for a $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ film on LaAlO_3 is shown in fig. 1. Its transition temperature is 89.6 K.

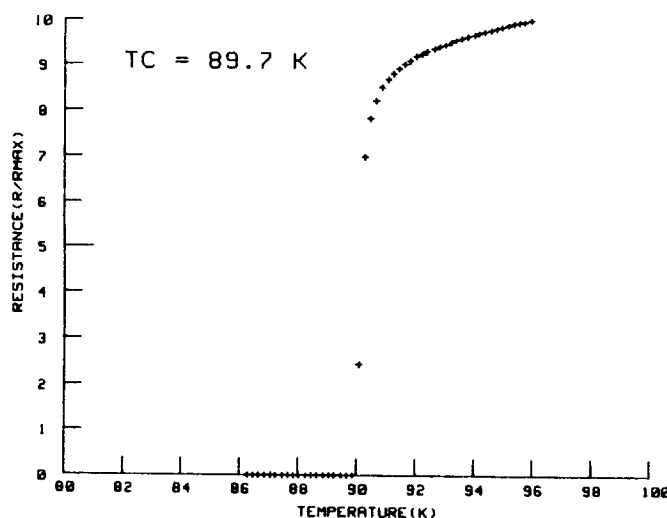


Fig. 1 Laser ablated $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ Film on LaAlO_3 .

Deposition temperature 610°C and oxygen pressure of 170 mtorr.

ORIGINAL PAGE IS
OF POOR QUALITY